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EXAMINER	
RODGERS, COLLEEN E	
ART UNIT	**PAPER NUMBER**
2813	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	09/945,535	AHN ET AL.	
	Examiner	Art Unit	
	Colleen E. Rodgers	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 March 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,6-10,14,15,19-23,27-31,35-37,51,52,54-56 and 62* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,6-10,14,15,19-23,27-31,35-37,51,52,54-56 and 62* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *See Continuation Sheet*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :08/21/06, 11/28/06 and 03/02/07.

DETAILED ACTION

1. This Office Action responds to the Amendment filed 2 March 2007. By this amendment, claims 1, 9, 14, 22, 30, 51 and 55 are amended and claims 5, 13, 18, 26 and 34 are canceled. Claims 1, 2, 6-10, 14, 15, 19-23, 27-31, 35-37, 51, 52, 54-56 and 62 remain pending.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 21 August 2006 was only partially considered by the Examiner, which was included with the Office Action dated 27 November 2006. The references in the "Other Documents – Non Patent Literature Documents" section were not previously considered. The related cases listed therein are hereby considered by the Examiner, and the IDS attached hereto with the others. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 2, 6, 7, 14, 15, 19, 20, 51, 52, 56 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589) in view of **Park** (USPN 5,795,808) and **Yano et al** (USPN 5,810,923).

Regarding claim 1, **Ma et al** disclose a method of forming a gate oxide on a transistor body region, comprising:

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting a single crystal semiconductor portion of the body region **52** [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 3, lines 1-4].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 and 200°C; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because **Park** demonstrates that they are art-recognized equivalent processes. While the deposition temperature disclosed by **Park** is slightly higher than claimed, these claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result

effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the deposition temperature to provide for processing limitations. Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claim 2, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein the metal layer is zirconium [see **Ma et al**, col. 2, line 67; see also **Park**, col. 4, line 25].

Regarding claim 6, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein oxidizing the metal layer includes oxidizing at a temperature of approximately 400°C [see **Yano et al**, col. 10, lines 1-8].

Regarding claim 7, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein oxidizing the metal layer includes oxidizing with atomic oxygen [see **Yano et al**, col. 21, lines 35-36].

Regarding claims 14 and 51, **Ma et al** disclose a method of forming a transistor [see Figs. 12 and 13] and the transistor formed thereby, comprising:

forming first and second source/drain regions [not shown; see col. 5, lines 42-43];

forming a body region **52** between the first and second source/drain regions;

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting a single crystal semiconductor region of the body region [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 3, lines 1-4]; and

coupling a gate to the metal oxide layer [see Fig. 13].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 to 200°C; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because **Park** demonstrates that they are art-recognized equivalent processes. While the deposition temperature disclosed by **Park** is slightly higher than claimed, these

claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the deposition temperature to provide for processing limitations. Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claims 15 and 52, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 14 and the transistor of claim 51, furthermore wherein the metal layer is zirconium [see **Ma et al**, col. 2, line 67; see also **Park**, col. 4, line 25].

Regarding claim 19, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 14, furthermore wherein oxidizing the metal layer includes oxidizing with atomic oxygen [see **Yano et al**, col. 21, lines 35-36].

Regarding claim 20, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 14, furthermore wherein oxidizing the metal layer includes oxidizing with atomic oxygen [see **Yano et al**, col. 21, lines 35-36].

Regarding claims 55 and 62, **Ma et al** disclose a method of forming a gate oxide on a transistor body region, comprising:

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting the body region, the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"; see also see col. 3, lines 1-4].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been

obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because **Park** demonstrates that they are art-recognized equivalent processes. Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claim 56, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 55. **Ma et al**, **Park** and **Yano et al** are silent as to the range of the conduction band offset. However, as the process steps are identical and there is no teaching as to modifying the process to achieve the specified range, it is considered to be a range of common use, and one of ordinary skill in the art would know how to optimize the process to achieve this range. See *In re Aller*, previously cited.

5. Claims 8-10, 21 and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589) in view of **Park** (USPN 5,795,808) and **Yano et al** (USPN 5,810,923) as

applied to claims 1, 2, 6, 7, 14, 15, 18-20, 51, 52, 55, 56 and 62 above, and further in view of **Moise et al** (USPN 6,211,035).

Regarding claims 8, 21 and 54, the prior art of **Ma et al**, **Park** and **Yano et al** teach the methods of claims 1, 14 and 51 as described above. None of **Ma et al**, **Park** and **Yano et al** teach oxidizing in a krypton/oxygen mixed plasma. **Ma et al** teach annealing in an oxygen plasma containing inert gases such as argon and nitrogen [see col. 6, lines 64-65]. **Moise et al** teach oxidizing a metal layer with inert gases such as argon and krypton [see col. 12, lines 23-24]. It would have been obvious to one of ordinary skill in the art at the time of invention to use krypton because **Moise et al** teaches that they are art-recognized equivalents.

Regarding claim 9, **Ma et al** disclose a method of forming a gate oxide on a transistor body region, comprising:

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting a single crystal semiconductor portion of the body region [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 3, lines 1-4].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 to 200°C, nor that the metal layer is oxidized using a krypton/oxygen mixed plasma; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and

the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because **Park** demonstrates that they are art-recognized equivalent processes. While the deposition temperature disclosed by **Park** is slightly higher than claimed, these claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the deposition temperature to provide for processing limitations. **Moise et al** teach oxidizing a metal layer with inert gases such as argon and krypton [see col. 12, lines 23-24]. It would have been obvious to one of ordinary skill in the art at the time of invention to use krypton because **Moise et al** teaches that they are art-recognized equivalents. Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no

criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claim 10, the prior art of **Ma et al**, **Park**, **Yano et al** and **Moise et al** teach the method of claim 9, furthermore wherein the metal layer is zirconium [see **Ma et al**, col. 2, line 67; see also **Park**, col. 4, line 25].

6. Claims 22, 23, 25, 27, 28, 30, 31, 33, 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589) in view of **Park** (USPN 5,795,808) and **Yano et al** (USPN 5,810,923) as applied to claims 1, 2, 6, 7, 14, 15, 18-20, 51, 52, 55, 56 and 62 above, and further in view of **Maiti et al** (USPN 6,020,024) and in view of the admitted prior art (pages 1-4).

Regarding claims 22 and 30, **Ma et al** disclose a method of forming an information handling system comprising:

forming a processor;

forming a memory array, comprising:

a number of access transistors, comprising:

forming first and second source/drain regions [not shown in Figs. 12 and 13; see col. 5, lines 42-43];

forming a semiconductor body region **52** between the first and second source/drain regions [see Fig. 12];

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting the semiconductor body region [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 3, lines 1-4]; and

coupling a gate to the metal oxide layer [see Fig. 13].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 to 200°C, nor the formation of word lines, source lines and bit lines; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because **Park** demonstrates that they are art-recognized equivalent processes. While the deposition temperature disclosed by **Park** is slightly higher than claimed, these claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the

prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the deposition temperature to provide for processing limitations. **Maiti et al** teach that transistors formed of a metal oxide with a high-k metal oxide gate are commonly used for integrated circuits. The admitted prior art (pages 1-4) teaches that these devices are commonly used in integrated circuits, particularly for processor chips, mobile telephones and memory devices. These devices typically employ word lines, source lines bit lines and system busses. Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claims 23 and 31, the prior art of **Ma et al**, **Park**, **Yano et al** and **Maiti et al** teach the method of claims 22 and 30, respectively, furthermore wherein the metal layer is zirconium [see **Ma et al**, col. 2, line 67; see also **Park**, col. 4, line 25].

Regarding claims 27 and 35, the prior art of **Ma et al**, **Park**, **Yano et al** and **Maiti et al** teach the method of claims 22 and 30, respectively, furthermore wherein oxidizing the metal layer includes oxidizing at a temperature of approximately 400°C [see **Yano et al**, col. 10, lines 1-8].

Regarding claims 28 and 36, the prior art of **Ma et al**, **Park**, **Yano et al** and **Maiti et al** teach the methods of claim 22 and 30, respectively, furthermore wherein oxidizing the metal layer includes oxidizing with atomic oxygen [see **Yano et al**, col. 21, lines 35-36].

7. Claims 29 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589), **Park** (USPN 5,795,808), **Yano et al** (USPN 5,810,923) and **Maiti et al** (USPN 6,020,024) as applied to claims 22, 23, 27, 28, 30, 31, 35 and 36 above, and further in view of **Moise et al** (USPN 6,211,035). The prior art of **Ma et al**, **Park**, **Yano et al** and **Maiti et al** teach the methods of claims 22 and 30 as described above. None of **Ma et al**, **Park**, **Yano et al** and **Maiti et al** teach oxidizing in a krypton/oxygen mixed plasma. **Ma et al** teach annealing in an oxygen plasma containing inert gases such as argon and nitrogen [see col. 6, lines 64-65]. **Moise et al** teach oxidizing a metal layer with inert gases such as argon and krypton [see col. 12, lines 23-24]. It would have been obvious to one of ordinary skill in the art at the time of invention to use krypton because **Moise et al** teaches that they are art-recognized equivalents.

Response to Arguments

8. Applicant's arguments filed 2 March 2007 have been fully considered but they are not persuasive.

With respect to the rejection of claims 1, 2, 6, 7, 14, 15, 19, 20, 51, 52, 55, 56 and 62, on page 9 of the Remarks, Applicant submits that there is no motivation to combine a reference such as **Ma et al** with a reference such as **Park** to arrive at the teaching of a layer of minimal roughness. The Examiner submits that the reference of **Yano et al** was additionally provided to answer this question. As cited above, **Yano et al** teach minimal roughness in a zirconium layer is achieved through evaporation deposition. On page 10 of the Remarks, Applicant submits that "a suggestion of not intentionally adding a trivalent metal does not suggest the use of highly purified metals, and requests the Examiner to specifically point out where such an objective suggestion might exist, as required under 35 USC § 103 to establish a *prima facie* case of obviousness." The Examiner submits that **Ma et al** teach, at col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%." Thus, while 25% of the trivalent metal is disclosed to be *preferred*, the range of 0-50% is taught. Also on page 10 of the Remarks, Applicant argues that "one of ordinary skill would not be motivated to change the teaching of Ma to obtain the present claimed arrangement of direct contact of the metal with the body region." However, **Ma et al** teach that the barrier layer is taught to be included in "some aspects of the invention," which means that the barrier is not present in *all* aspects of the invention, which makes the barrier layer optional. Whether or not it is preferred by **Ma et al**, for the stated benefit of improving electron mobility, the barrier is not required.

With respect to the rejection of claims 8-10, 21 and 54, on page 11 of the Remarks, Applicant argues that **Moise et al** does not remedy the alleged deficiencies of **Ma et al**, **Park** and

Yano et al. The Examiner submits that the cited arts are not deficient, as explained above. Therefore, the rejection of claims 8-10, 21 and 54 stands.

With respect to the rejection of claims 22, 23, 27, 28, 30, 31, 35 and 36, on pages 11 and 12 of the Remarks, Applicant argues that **Maiti et al** does not remedy the alleged deficiencies of **Ma et al**, **Park** and **Yano et al**. The Examiner submits that the cited arts are not deficient, as explained above. Therefore, the rejection of claims 22, 23, 27, 28, 30, 31, 35 and 36 stands.

With respect to the rejection of claims 29 and 37, on pages 12 and 13 of the Remarks, Applicant argues that the cited references are deficient as addressed above. The Examiner submits that the cited arts are not deficient. Therefore, the rejection of claims 29 and 37 stands.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colleen E. Rodgers whose telephone number is (571) 272-8603. The examiner can normally be reached on Monday through Friday, 9:00 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CER

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